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ECO-FRIENDLY PAVEMENT BLOCKS OF WASTE GLASS FLY ASH AND DUST

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ABSTRACT

The present experimental investigation examines the effect of waste glass, fly ash as partial replacement to cement and dust as partial replacement to fine aggregate on the various properties of pavement block. Investigation is done on M30 mix using fly ash as partial replacement to cement in various percentage by weight of cement such as 25 and 50, also waste glass and dust as partial replacement to fine aggregate. The paving blocks face different problems such as the rutting failure, uneven settlement, less durability. The paving block fails at the least surface area and the edges due to bending action. Principal forms of pavement damage are traffic-induced ruts and cracking, lipping and damage to pavers caused by container stacking. In this work, to overcome this problems the properties of the paving block are enhanced by using fly ash, waste glass, optimum dose of plasticizer, replacement of fine aggregate by dust etc.

KEYWORDS: Fly Ash, Waste Glass, Cement, Stone Dust and Pavement Block

INTRODUCTION

Pavement blocks, which are industrial products of pre-fabricated unarmed concrete, having various dimensions and special morphology are used for pavement laying of residential projects carrying pedestrian and vehicular traffic. Cement concrete paving blocks are precast solid products made out of cement concrete. The product is made in various sizes and shapes viz. rectangular, square and round blocks of different dimensions with designs for interlocking of adjacent tiles blocks. The raw materials required for manufacture of the product are Portland cement and aggregates which are available locally in every part of the country. This paper presents a brief review of relevant researches in Pavement Blocks for influencing the properties of Pavement Blocks. **Johnson** [1] carried a parametric experimental study for producing paving blocks using waste glass as fine as well as coarse aggregate.**Shayan and Xu** [2] reported fine glass powder for incorporation into concrete up to 30% as a pozzolanic material suppressed the Alkali Silica Reaction. **Topcu and Canbaz** [3] reported the waste glass in size of 4-16 mm used as aggregate in the concrete reduced the compressive strength of concrete.

Tuncan et al [4] showed the addition of waste glass powder (15%) into concrete increased the compressive strength of concrete as much as 13%. **Kısacık** [5] also reported the compressive strength of concrete with waste glass decreased 19%. **Park et al** [6] has study of 30% of waste glass with size of 0-5 mm addition into concrete decreased the compressive strength of concrete as much as 4%. **Sangha et *al.*** [7] investigated the effect on concrete strength of green glass as an aggregate replacement. They observed that increases in the compressive strength values at the 10%, 40%, and 60% aggregate replacement by waste glass with 0- 10 mm particle size were 3%, 8% and 5% as compared with control sample without waste glass but decrease in the compressive strength value was 2% at the 20% replacement. This paper shows that the replacement of FG by FA at level of 20% by weight has significant effect on the compressive strength, flexural strength, splitting tensile strength and abrasion resistance of the paving blocks with FG compared with the control sample

while the beneficial effect on these properties of CG replacement with FA by weight is little. **Papayianni** [8] conducted research on paving blocks with fly ash.

EXPERIMENTAL INVESTIGATION

Locally available OPC 53 confirming to IS standards was used. Fine aggregates confirming to grading zone-II of Table 4 of IS383-1970 were used. Machine crushed black basalt aggregate, 20mm nominal size confirming to IS383-1970 was obtained from local quarry. Portable water was used in this experimental work.

To start with M30 concrete mix design was carried out following IS10262-2009 & using normal ingredients including aggregates. In the next series of specimen preparation, however natural sand was replaced with20% by waste glass as well as with 50% of stone dust. In addition to replacing natural sand, cement was also replaced with fly ash. Fly ash addition levels were 25%, 35%and 50% by weight of cement. The experimental work included testing mechanical properties such as compressive strength, flexural strength and abrasive resistance. Almost all the specimens were water cured up to 7 days before testing.

RESULTS AND DISCUSSIONS

Table1 compares the compressive strength, flexural strength and abrasive resistance of concrete paving blocks containing waste glass, stone dust, admixture and fly ash with those of the plain cement concrete. As the percentage of the waste glass changes there is variation in the strength of the paving block. The figure 1 and 2 shows that 20% replacement of fine aggregate by glass waste gives better compressive strength, flexural strength respectively (Table1). The paving blocks made by replacing 25% of fly ash against cement, admixture 0.35% by weight of cement and replacement of fine aggregate by 50% of stone dust shows the best strength among the concrete pavement blocks containing other waste. The reason may be in the filling of voids by glass waste.

CONCLUSIONS

The cured paving blocks gives more compressive strength, flexural strength and abrasive resistance than non-cured blocks. The compressive strength and flexural strength of cured block is increased by 37% and 50% respectively. As the blocks generally fail at the edges due to bending, may get sustain by proper curing. Incorporating 20% waste glass in placed of sand in concrete paving block gives acceptable mechanical properties. Replacing of 25% fly ash against cement, provides desirable compressive strength and flexural strength. The breaking load is adequate, so these blocks can be used for heavy duty industrial roads as per IS15658-2206.Based on the investigation so far conducted, it can concluded that as vibration duration(i.e. vibration distance)increases the concrete paving blocks gives the better result for compressive strength and flexural strength. Hence at the time of casting, the paving block should vibrated up to 3 to 5 minutes.

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9. Indian standard fine aggregate confirming to IS 383:1970.

10. Indian standard for particle size distribution of aggregate confirming to

11. IS 2386: (Part I and Part III) 1963.

12. Indian standard for Portland pozzolana cement (fly ash based) confirming to IS 1489 (Part I) 1991.

APPENDICES

Table 1: Results of the Test Carried on Paving Block

Sr. No.	Types of Blocks		Compressive Strength (N/Mm²)	Flexural Strength (N/Mm²)	Abrasive Resistance (Mm³)
1	Vibrating distance				
	i)	12 feet			
		a) Cured (C)	67.08	8.18	-
		b) Non cured (NC)	42.52	4.11	-
	ii)	8feet (C)	57.98	7.73	-
	iii)	6feet (C)	54.77	7.3	-
2	20% replacement of F.A. by waste glass (C)		61.29	8.91	2148.70
3	Varying % of fly ash				-
	i)	25% by weight of cement (C)	41.7	6.99	2707.09
	ii)	50%by weight of cement(C)	30.08	3.27	3247.42
	iii)	Jaypee cement &35% fly ash (C)	35.56	4.7	-
4	Admixture 0.35% by weight of cement (C)		59.40	7.63	-
5	50% F.A. by dust(C)		61.07	7.48	-

Table 2: Results of a brasion Resistance Test

Specimen	Sr. No.	Initial Weight (Kg)	Final Weight (Kg)	(Dm) Loss of Weight (Kg)	Density of Specimen (Kg/M³)	Dv= Dm/Density (Mm3)
Fly ash 50% replacement	1.	0.601	0.594	7 / 1000	2155.55	3247.42
Fly ash 25% replacement	2.	0.616	0.610	6/1000	2216.40	2707.09
Waste glass replacement	3.	0.591	0.586	5/1000	2326.98	2148.70

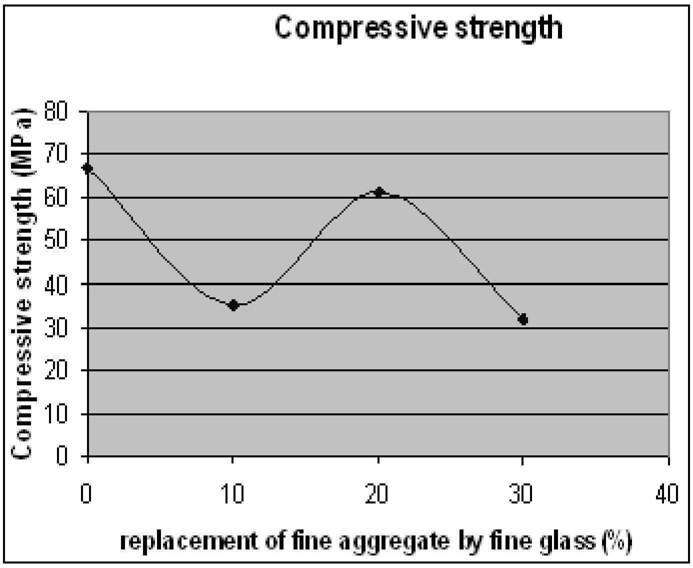

Figure 1: Variation of the Compressive Strength

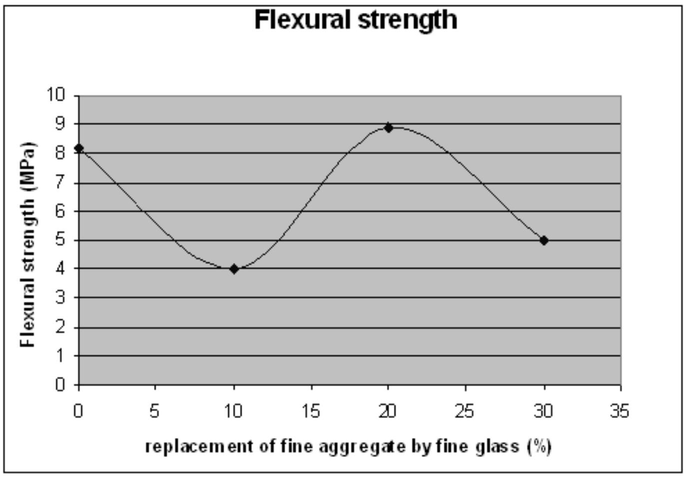

Figure 2: Variation of the Flexural Strength

Figure 3: Failure of Pavement Blocks after Flexural Strength Test